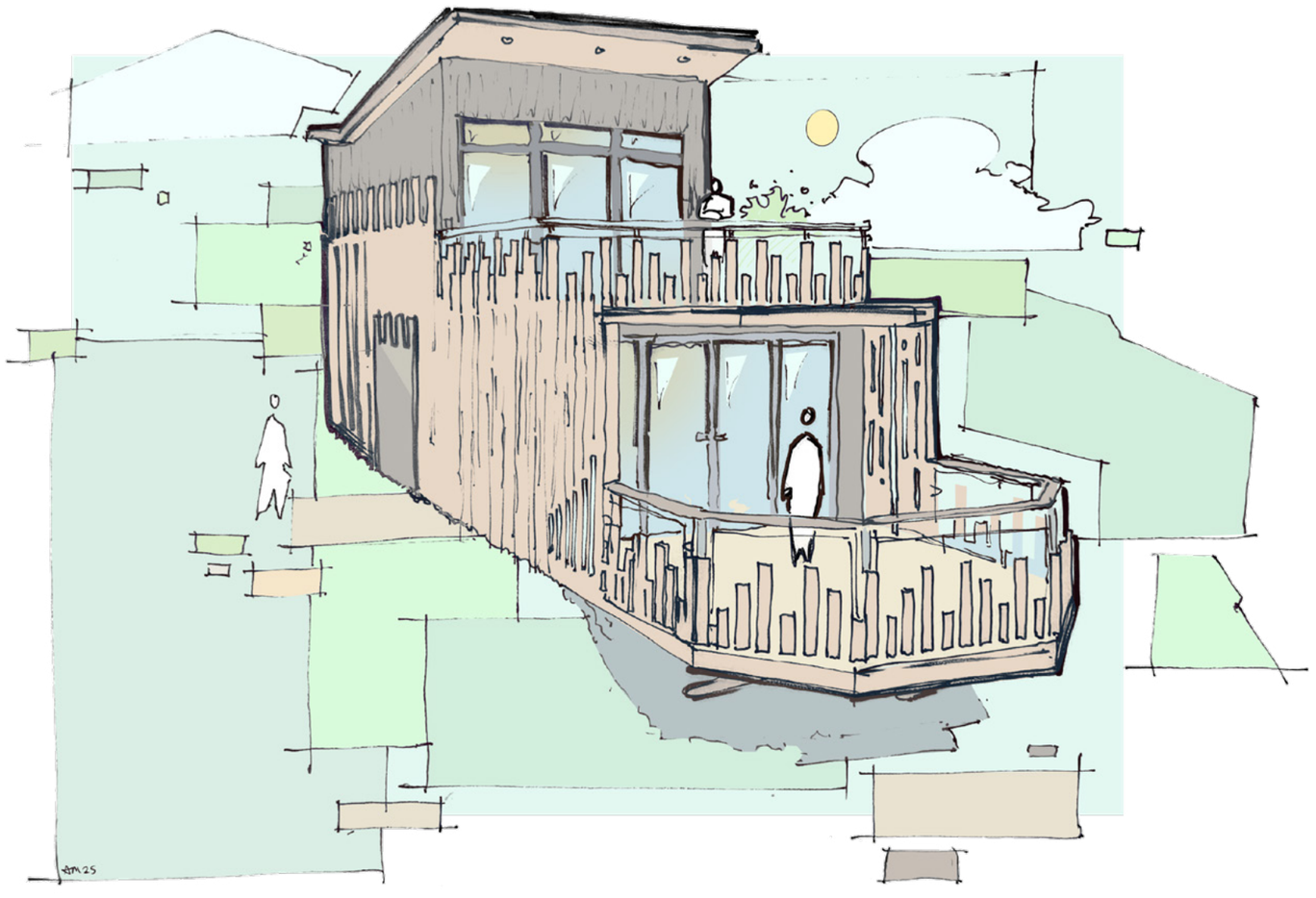

Alexander Murray - 22023585 - PS 3.1

Contributing Group Members:

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Word Count: 1632

Lochaber Research Project

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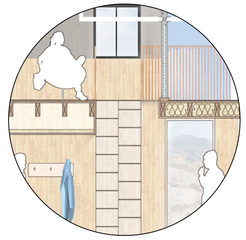
Design Intentions



Passivhaus Standards

Balanced Work/Life Dynamic

Loose Fit Design

Report Prepared for: Client, Investors

Project Summary

Overview

This wildlife observatory is based in Ardnamurchan, Lochaber. It is located on the outside edge of a crater - the remnants of a long-extinct volcano whose scale is almost too vast to comprehend, unless seen from above.

This observatory, which overlooks Sanna Bay, is capable of accommodating 3 people. Its layout includes a compact kitchen, an internal convivial area, a bedroom, circulation space and the main observatory - all contained within a gross internal floor area of 77m^2.

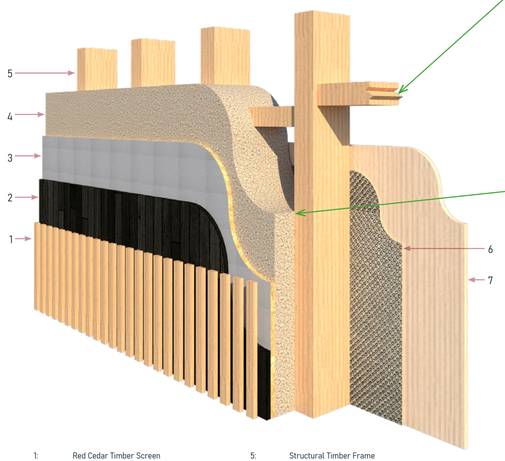
Moreover, the surrounding views are captured by the balcony spaces on each floor - the ground floor acting as an extension to the observatory, and the 1st Floor acting as an extension to the internal convivial space. This allows for a cohesive layout as well as sufficient visual connections to the bay.

For this project, we set out 3 key objectives:

- This building should meet passivhaus standards in terms of carbon emissions and thermal conductivity
- This design should include a balanced work/life dynamic
- This design should be 'toose-fit' - capable of being used for functions other than an observatory to ensure the longevity of the building

Side view of Observatory
Credit: Daniel Gallagher

NW-facing View of Sanna Bay from Observatory

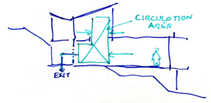


1:	Red Cedar Timber Screen	5:	Structural Timber Frame
2:	Charred Timber External Cladding	6:	VCL
3:	Breather Membrane over OSB Sheathing	7:	Douglas Fir Internal Cladding
4:	300 mm Insulative Hempcrete (0.186 W/m^{2}K)	Total U-Value = 0.136 W/m^{2}K	

In terms of sustainability considerations, we used timber as our primary building resource (present in the cladding, structure, and furnishing of the building) as it is a carbon-negative material which can be obtained locally within Lochaber. However, due to this heavy use of timber, which is flammable compared to that of steel or concrete, we had to carefully consider our design in terms of fire safety aspects.

In that respect, we included hempcrete in the wall buildup, as it's a carbon-negative, fire-resistant material which serves as a loose passive heating system, as it can store a sufficient amount of thermal mass during the day, which releases throughout the night. Additionally, the species of wood we used, such as red cedar and douglas fir, have optimal fire resistant qualities compared to alternative wood species. Moreover, we included charred timber on the exterior cladding due to its fire resistant properties.

In terms of spacial coordination, our design includes a clear circulation area, which leads directly to the exit, eliminating any confusion as to where to escape during an emergency.



Client Priorities

The client for this project is the University of the Highlands and Islands, to support research opportunities which looks into observing local wildlife within the highlands.

Much like a number of other institutions, the UHI has seen decreased funding in recent years, therefore both embodied and operational cost is a primary concern in this design. Therefore, for a project this size, a total cost of around £400K-600K would be ideal.

As far as quality is concerned in this building, the client wants low maintenance, weather resistant materials in order to ensure a low-cost upkeep of the structure. Additionally, we have decided on using prefabricated components for assembly, which would attach to a concrete slab foundation, to ensure a swift assembly of the structure.

Competencies

Throughout the RIBA Plan of Work, the architect is involved from initial conceptualisation of the project until the handover. These competencies can be evidenced through continuous illustrations/sketches, or a time sheet for accuracy.

In terms of the architect's role at each stage of work, their role would generally involve: (see table)

Stage 0: **"Strategic Definition"**	Outlining the client's priorities, while reviewing the project risks and budget.
Stage 1: **"Preperation & Briefing"**	Helping define the project brief and creating a project execution plan, by considering sustainability strategies, quality aspirations and spatial requirements.
Stage 2: **"Concept Design"**	Responsing to the brief by creating an Architectural Concept, which incorporates strategic engineering and considers the cost plan, project strategies and outline specification as well as building regulations.
Stage 3: **"Spatial Coordination"**	Coordinating spatial elements through design studies, engineering analysis and reviewing building regulations in much more depth.
Stage 4: **"Technical Design"**	Finalising the architectural/engineer's technical elements of the design, which involves responding to site logistics, preparing the design programme, and resolving site queries.

Further stages of the RIBA Plan of Work involve the manufacturing & construction of the building [Stage 5], the Handover [Stage 6], and the use of the building [Stage 7][1], in which the Architect may help inform logistics, quality control, client handover, post-occupancy evaluation, and in monitoring building performance.

1 Dale Sinclair, Alex Tait, Lucy Carmichael, Plan of Work 2020 Overview (London: RIBA, 2020), pp. 30 35-71.

Consultants

The team of consulatants required to complete the next stages of the project (RIBA Stages 3-7) would include of Quantity Surveyors, MEP Engineers, and Structural Engineers.

The Q.S. would be required to carry out continuous cost analysis. The M.E.P. Engineer would be required to oversee of mechanical, electrical and plumbing systems as well as their compliance with regulations. A Structural Engineer would be required to ensure the building is structurally durable.

The consultant who would take the role as principle designer, as per CDM 2015, would be the architectural practice. The principle designer is an organisation or an individual, appointed by the client, who takes control during the pre-construction phase of any project which involved more than one contractor.[2]

The architectal practice would take on this role, as in this instance, the practice has deep insight into the planning and management of the project. Additionally, the firm has sufficient knowledge of health and safety aspects in both current development and future delivery, as well as maintaining communication between all parties during this phase.[3]
The areas of legislation which impact this project the most prominently mainly consist of fire safety regulations, due to this structure being part residential.

2 UK Government. 2015. The Construction (Design and Management) Regulations 2015. London: The Stationery Office, https://www.hse.gov.uk/construction/cdm/2015/index.htm

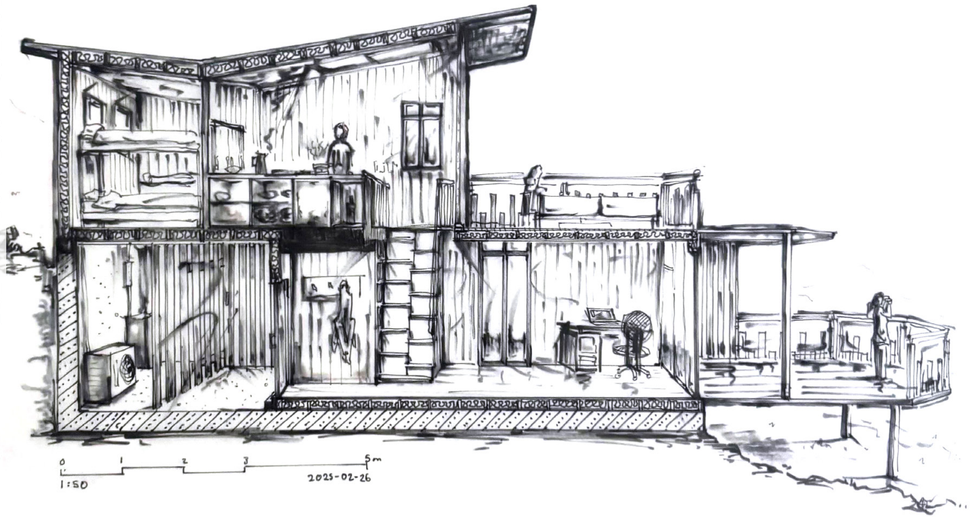
3 Royal Institute of British Architects. Principal Designer Register Competence Criteria. Updated May 2024. Accessed February 18, 2025.

Legislation

Standard 2.1, Compartmentation & Structural Fire Protection, from the Building standards technical handbook (June 2023) states that every building must be designed & constructed in a way that fire & smoke will not spread beyond the compartment of origin until any occupants have had the time to leave that compartment. This standard is seen in our design due to how the observatory is organised.

Additionally, Standard 2.2, Spread of Flame on External Walls, is incorporated in this design by using charred timber, in which volatile compounds have been removed, which creates a protective carbonised surface, mitigating the spread of flame on the external cladding. Moreover, the addition of hempcrete, over an alternative combustable insulative material, helps stop fire spread due to its fire resistance.

The concrete slab which takes the load of the building meets the requirement of Standard 1.1, which ensures the structural durability of a building.[4]



4 Scottish Government, Scottish Building Standards 2023, Scottish Government, pp. 59, 84-85 https://www.gov.scot/policies/building-standards/

Sustainability

The sustainability strategy of this project mainly resides in the choice of materilaity, which uses carbon-negative materials such as hempcrete and timber. We decided to use hempcrete in the wall buildup as an insulative material as in a way, hemp is a wonder plant, as it absorbs more CO^2 than trees. A single hectare of hemp can sequester up to 15 tonnes of CO^2 per year. However, hemp requires the proper licensing to use in construction due to it being classified as cannabis.[1, 2]

Additionally, with the help of our Q.S., we were able to find sources for our materials within 100 miles of our site in order to mitigate carbon emissions through the delivery of the materials. In terms of recycled materials, we implemented re-used aerogel within select double glazing openings in order to improve thermal efficiency of the structure.

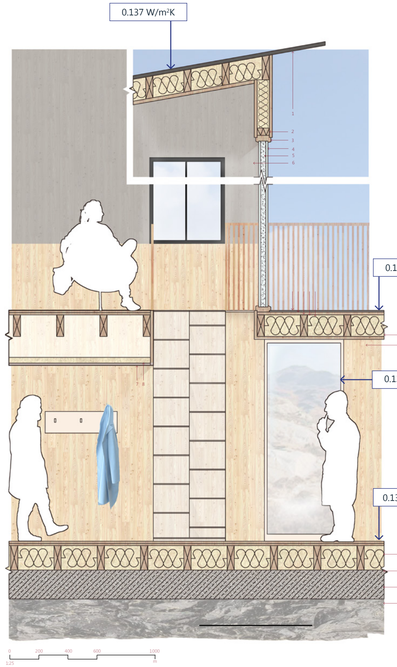
Furthermore, our approach aligns with sustainability requirements outlined in UK legislation, such as the **Building Regulations Part L**[3], which mandates energy efficiency in buildings, and the **Climate Change Act 2008**[4], which sets legally binding carbon reduction targets. By utilising carbon-negative materials like hempcrete and timber, as well as sourcing materials locally, we contribute to the UK's goal of achieving net-zero emissions by 2050.

1 United Kingdom, Misuse of Drugs Act 1971: Chapter 38, Published May 27 1971, Accessed February 14 2025, https://www.legislation.gov.uk/ukpga/1971/38/contents.

2 United Kingdom, The Misuse of Drugs Regulations 2001: Statutory Instrument 2001 No. 3998, Enacted December 10 2001, Accessed Febuary 19 2025. https://www.legislation.gov.uk/uksi/2001/3998/contents.

3 United Kingdom. The Building Regulations 2010: Conservation of Fuel and Power (Approved Document L). Updated 2021. Accessed Febuary 24, 2025. https://www.legislation.gov.uk/uksi/2010/2214/contents.

4 United Kingdom. Climate Change Act 2008: Chapter 27. Enacted November 26, 2008. Accessed Febuary 24, 2025. https://www.legislation.gov.uk/ukpga/2008/27/contents.



1:	1200x800mm Corrugated Hemp Fiber Panels
2:	Insulation Cap
3:	Timber Window Frame
4:	Double Glazing
5:	16 mm Insulative Aerogel
6:	Charred Timber Internal Cladding
7:	Fake Ceiling (2 mm)
8:	100mm Soundproofing
9:	VCL
10:	Douglas Fir Internal Cladding
11:	300mm
12:	DPM
13:	275mm Concrete Foundation
14:	Ground (Andesitic Pichosiene)

Material list
External Cladding – Thermowood
Insulation – Aerogel
Structural Elements – Modular Timber frame
Flooring – wood (sustainable sourced)
Internal finishes – recycled plasterboard, low VOC paint

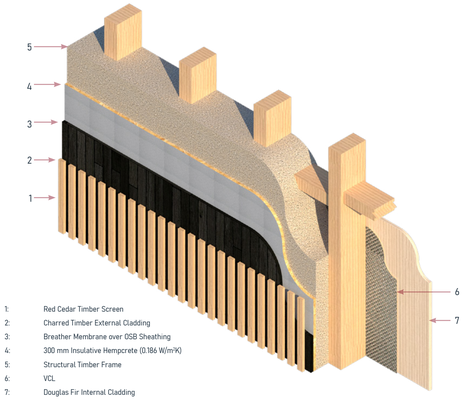
Maintenance
Thermowood cladding – £250 – Every 5 years
Aerogel – NON
Timber frame units – inspection every 10 years - £250
Corten steel roof – minimal preventative rust easy yearly - £100
M&E servicing - £500

Carbon costing
New builds – 40000 kgco2e
New build off site – 17000 kgco2e
Ours 13160 kgco2e
100 mile radius of materials

Gross internal floor area – 77m²
Timeline of 26 weeks – Compared to size of alternative projects
Modular construction – 8 prefabricated units delivered
Costly areas Corton, Aerogel and GGBS
Build cost - £403,695
15% risk - £60,554

Total cost - £464,249

Key Section showing Dynamic between circulation space, living space and observatory



1: Red Cedar Timber Screen
2: Charred Timber External Cladding
3: Breather Membrane over OSB Sheathing
4: 300 mm Insulative Hempcrete (0.186 W/m²K)
5: Structural Timber Frame
6: VCL
7: Douglas Fir Internal Cladding

Total U-Value = 0.136 W/m²K

Fire/Life Safety

We included hempcrete in the wall buildup, as it's a carbon-negative, fire-resistant material which serves as a loose passive heating system. This system stores a sufficient amount of thermal mass during the day, which releases into the interior throughout the night.

Hemp on its own is combustable, however the addition of lime in hempcrete allows it to be highly tolerant to fire. According to UK fire safety standards, hempcrete has demonstrated its ability to withstand significant damage from fire for several hours.[1]

Additionally, the species of wood we used, such as red cedar and douglas fir, have optimal fire resistant qualities, compared to alternative wood species, due to its density. Moreover, we included charred timber on the exterior cladding due to its fire resistant properties. The outer carbonised layer of the charred timber acts as a protective barrier, slowing combustion and reducing the rate of which flames can penetrate the wood.

In terms of spacial coordination, our design includes a clear circulation area, which leads directly to the exit, eliminating any confusion as to where to escape or barriers during an emergency.[2]

1 BRE. Hemp-Lime Construction: A Guide to Building with Hemp-Lime Composites. Watford, UK: BRE Press, 2006.

2 HM Government, The Building Regulations 2010: Approved Document B – Fire Safety, London: NBS, 2019.

Interior Axonometric Showcasing circulation space between Workspace and Living space

Risk Assessment

	Risk Description	Rationale for Selection	How the Risk can be Mitigated
1	**Delivery delays due to remote location or the windy roads.**	The site is located on a fairly remote peninsula. Additionally, the site is located on the opposite side of the main access point (thorugh ferry).	Through careful planning, considering weather and other environmental factors, ensuring a smooth delivery to site from sources without obstacles
2	**Insufficient funding to complete project.**	This should be considered, despite the low cost predicted of the project, as circimstances may change which could lead to increased costs.	Ensuring the project goes ahead as planned during Stages 0-2, without major changes. Alternatively, consider extra sources of funding.
3	**Tensions between contributing parties (i.e. architectural team, contractors, engineers, etc.)**	Although there was a healthy relationship between all parties during Stages 1-2, tensions should be considered throughout later stages of the project.	Healthy conversations & constant communication between all parties.

Finance

In relation to the architectural considerations of the project, we chose to create this structure to **passivhaus standards**. This causes the initial construction of the building to be more expensive, however, the incorporation of passivhaus standards allows for lower operational cost overtime.

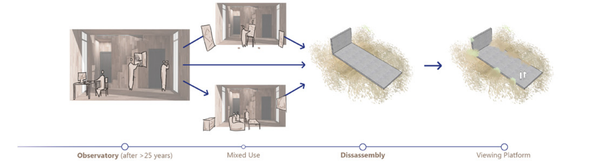
Additionally, we considered **maintenance** in this design. For the external timber screen, we used red cedar, due to it's weather resistance. This material can last up to 40-60 years. The inclusion of charred timber was also a consideration in this respect as it can last up to 50-100 years, due to its similar properties. Finally, the hemp fibre corrugate panels used in the roofing can last for hundreds of years due to its high cellulose content.

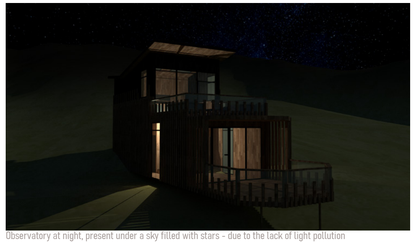
In terms of the financial aspect of the delivery of the project, we utilised **locally sourced materials**. With the help of our Q.S., we were able to find contractors for our selected materials within 100 miles of the site, in order to reduce the carbon emissions and cost of the project.

Moreover, we incorporated **inexpensive materials** such as timber and concrete in order to balance out the increased cost by incorporating passivhaus building standards.

Procurement Route

A Design and Build (D&B) procurement route with a JCT Design and Build 2024 contract would be optimal due to its cost certainty, risk allocation and sustainability compliance. D&B ensures single-point responsibility, integrates specialist contractors early, and accelerates the programme. The JCT D&B 2024 contract aligns with Building Regulations Part L and the Climate Change Act 2008, supporting carbon-negative materials like hempcrete. Its performance-based specifications ensure sustainability while minimizing client risk.





Observatory at night, present under a sky filled with stars - due to the lack of light pollution

Dynamic between outdoor convivial space & internal convivial space

Shot of Circulation Space from Observatory

Role of the Architect

The Architect should consider the cost of materials they specify - in both initial cost, as well as the cost of upkeep/maintenance. This can be informed by input from the Q.S.

Additionally, fire/life safety aspects should heavily be considered in terms of materiality choice and spatial organisation (making sure there's no barriers in case of an emergency when peopale need to escape the building). This can be informed by a fire safety expert.

Moreover, ensuring a building is sustainably constructed is another key consideration in terms of materiality choice and construction methods. This can be informed by a sustaibability consultant.

-- end of report --

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